UNITED STATES
DEPARTMENT OF
AGRICULTURE

Forest Service

Northeastern Area

Biological Evaluation of Browntail Moth on Cape Cod National Seashore-1987

Biological Evaluation

February 1987

Prepared by: Parker Snowden, Entomologist, USDA Forest Service, Forest Pest Management, P. O. Box 640, Durham, New Hampshire

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ABSTRACT

The browntail moth, Euproctis chrysorrhoea L., an insect introduced from Europe in the 1890s, became a widespread and serious defoliator of fruit trees, ornamental shrubs and trees, and forest trees throughout northeastern North America. However, for unknown reasons the population declined and is now restricted to isolated islands in Casco Bay, Maine and to outer Cape Cod, Massachusetts.

Evaluations indicate that beach plum, a primary host plant and important member of the dune community, is now being severely damaged and killed by browntail moth on Cape Cod National Seashore.

Besides being a defoliator on shrubs and trees, the larvae and moths have specialized setae or hairs can cause a severe rash to humans.

In about 1982 on the Seashore, infestations moved inland from four isolated areas of about 640 acres. The gross area of infestation in 1986 on and near the Park property is about 4400 acres, within which about 1260 acres of scattered infestations can be delineated. The infestations may intensify and spread further inland.

If browntail moth continues to cause severe damage to beach plum, it will no longer be a major plant species of the dune community. This ecological loss will compound the problem of stabilizing the dunes. Other host plants, invertebrates, vertebrates, and people may also be adversely affected if the population is not reduced to manageable levels.

Of the five management options available to Cape Cod National Seashore - no action, removal of overwintering webs by hand clipping, suppression with a biological insecticide, suppression with a chemical insecticide, and an integrated pest management program combining several methods (IPM) - IPM is recommended to reduce the population density to a level that can be managed effectively.

INTRODUCTION

The browntail moth, Euproctis chrysorrhoea L., a native of Europe, is a defoliator of plants, especially trees and shrubs. It was discovered in North America in Somerville, Massachusetts in 1897, and probably had been imported on nursery or florist stock from Holland or France. For many years, the insect was a serious pest on apples, pears, garden crops, ornamental shrubs, and numerous shade trees and forest trees in eastern New England, New Brunswick, and Nova Scotia. Between 1920 and 1940, for unknown reasons the population declined dramatically in most areas, and browntail moth is now restricted to isolated islands in Casco Bay, Maine, and outer Cape Cod, Massachusetts, especially the sand dunes. On the islands of Casco Bay, browntail moth feeds primarily on Crataegus spp. (hawthorn) and Quercus rubra (red oak). On Cape Cod, the principal host plant is Prunus maritima (beach plum).

Browntail moth is closely related to gypsy moth, and in respects other than their color, browntail moth larvae resemble gypsy moth larvae. But unlike the gypsy moths that overwinter in the egg stage, browntail moths overwinter as second and third instar larvae in tough, silky webs spun by the larvae. These webs, spun in the fall, are conspicuous on the terminal twigs of host plants. The larvae emerge from the webs in the spring and commence feeding on the foliage. The larvae migrate readily, and new infestations can be created by them as well as by the adults.

The primary host on Cape Cod, beach plum, is a straggling densely-branched deciduous shrub that grows from 1 to about 5 feet in height. It is native to coastal sand dunes, and sandy and loamy soils inland. It has a high tolerance to salt sprays and strong winds and is a major plant species of the dune community. It is important among those plants that serve as barriers to trap wind-blown sand and stabilize the dunes. It also protects shore property from damage caused by storms and wind. The white spring flowers beautify the Cape seashore. For connoisseurs of special foods, the purple berries that ripen in the fall make a delicious jelly that is often marketed in New England.

A characteristic of beach plum that increases its susceptibility to damage by browntail moth is its late foliation compared to other plants in the spring. The larvae are usually active before the beach plum foliates and eat the buds before or as they burst and they may also eat the petals of the flowers. The larvae may migrate from other already foliated hosts to the tender preferred beach plum. Because the foliage has not expanded, the relative consumption of foliage per larva is very high.

Other host plants such as shadbush, black cherry, salt spray rose, and bear and red oaks are also subject to defoliation by the larvae.

Browntail larvae, as well as the adults, have specialized setae (hairs) that contain toxin. These urticating hairs rapidly penetrate the skin of humans, causing a severe rash and/or irritation.

Beginning in 1982 on Cape Cod, browntail moth has spread rapidly from the dunes to inland areas, and it has moved into residential areas so more people being more subjected to the discomfort of the rash.

Several attempts have been made in the past to control browntail moth in localized areas on Cape Cod. Suppression projects conducted 1965-1968, using a combination of chemical insecticides and handclipping the webs, were apparently effective in reducing the browntail moth populations. A field evaluation of

two formulations of Bacillus thuringiensis (Bt), conducted in 1974, showed that neither reduced populations below 56 percent of prespray counts. Better timing of the applications might have improved their performance (McLane and others 1978). Although another test was conducted on the Seashore in 1985 using Bt, the intent of the test was to determine the effect of the insecticide on non-target lepidopterous larvae. The effect on browntailmoth populations was not measured.(Mello 1985). Removing webs from host plants by handclipping has proven to be an effective suppression method where browntail moth populations are light to moderate.

In 1986, the National Park Service requested forest pest suppression funds to suppress the expanding infestation of browntail moth in 1987 and 1988. The objectives of this evaluation are to document the impact of the insect on the plant community and to recommend a program to reduce the population to manageable levels on the Seashore.

THE IMPACTS OF BROWNTAIL MOTH

Impact of Browntail Moth on Beach Plum and Other Preferred Host Plants

Beginning in 1984, plots were established in infested areas to measure the defoliation rate (per larvae and per web) that could be expected from the population then present (see Appendix). The plots indicate that browntail moth is causing extensive branch dieback and mortality to beach plum and other preferred host shrubs. In 15 five-meter radius plots established in live shrubs in 1984, 90 percent of the beach plum were dead in 1985. These plots could not be used to measure defoliation rates in 1985. When new plots were established in 1985, mortality was again high in the plots. About 93 percent of the shrubs were dead in 1986. New plots were again established in 1986 in previously very lightly defoliated areas. These plots were moderately to severely defoliated in 1986, but overall mortality was low - 7 percent. However, another years defoliation may have different results. Data from the earlier plots indicate that two consecutive years of moderate to severe defoliation result in severe shrub damage or mortality.

On the dunes, the stems and lower branches of beach plum are usually buried in sand and the roots are far beneath the surface. What appears to be a group of shrubs is actually the tips of the several branches of a single plant. The tips can be killed by browntail moth larvae while the main part of the plant remains alive. New branches may be produced later or live branches covered with sand when other branches were defoliated may be uncovered by strong winds, permitting the plant to survive. The 1984 plots described above were examined again in 1986. No new foliage was visible. Thus the damaged beach plums are presumably dead.

If browntail moth continues to cause severe damage and mortality to beach plum, the shrub will no longer exist as a major plant species of the dunes. This would be a serious ecological loss and will compound the problem of stabilizing the dunes.

Impact of Browntail Moth on Vertebrates and Invertebrates

Severe damage of beach plum and other preferred host shrubs and trees

caused by browntail moth may have an adverse effect on the population, habitat, and breeding grounds of many vertebrates and invertebrates. More than 15 species of bird feed on the fruits of beach plums, mulberry, shadbush, salt spray rose, and black cherry, in addition to other shrubs and tree species (Fernald 1903). For example, cedar waxwing and scarlet tanager feed predominantly on fruits (DeGraaf and Rudis 1986). Cedar waxwing, hermit thrush, and eastern bluebird, which are not too common on the Cape, may become scarce if their food sources are restricted. These birds may move to other areas for a home or breeding site.

In addition, about 11 mammals feed on the fruits, acorns, and bark of beach plum, shadbush, black cherry, mulberry, and scrub oak. Likewise, if these plants are no longer available to mammals, they will seek other areas for food and shelter.

Although little information is available concerning the impact of browntail moth on invertebrates, Mark Mello of the Center of Coastal Studies, Provincetown, Massachusetts indicated in his 1985 study that two rare species of Lepidoptera, Eumacaria latiferrugata and Sphinx drupiferarum, feed on beach plum as a primary food source and may not survive if beach plum are seriously damaged or killed by browntail moth.

The Impact of Browntail Moth on People

Adults and larvae of browntail moth are also known to cause severe skin irritation to humans, much more severe than a similar rash caused by gypsy moths. The bodies of browntail moth larvae are equipped with urticating hairs which easily break off on the skin causing a serious rash and itch which may last for several weeks. Sometimes the affliction is so severe and painful that a person can become seriously ill. Even the hairs floating in the air during the larval molting periods can cause skin irritation. If many hairs are breathed into the lungs, a person could have severe complications in breathing. The author has experienced the rash while working with the insect, even though petroleum jelly was applied to the exposed skin areas and gloves and disposable light weight coveralls were worn. As the infestation advances inland to residential districts, more people will be exposed to the hairs of the larvae and moths. Visitors who contact the rash will likely attribute it to other causes, such as poison ivy or mosquito or sand fly bites, but the residents soon learn about the browntail moth, and the insect is a source of antagonism toward the Park Service.

DISTRIBUTION OF BROWNTAIL MOTH INFESTATION FROM 1965 TO 1986

In 1965 a survey was made by the Forest Service with the cooperation of the Park Service to delineate the infestation of browntail moth on Cape Cod National Seashore. Approximately 460 acres around Long Point, Race Point, Provencetown Beach (now Herring Cove Beach), and Pilgrim Heights were infested (Schneider 1966) (see map 1). A few informal surveys may have been made after 1965, but it was not until 1982 that another formal survey was made by the Forest Service and the Park Service to assess damage caused by browntail moths. During the survey new infestations were detected in old infested areas

in Pilgrim Springs, Herring Cove Beach, and Head of the Meadow Beach. Also, new infestations were detected by the Park Service personnel in formerly infested areas on Long Point. Then in 1983 an extensive survey was made by the Park Service from Long Point, south to Newcomb Hollow and west to Ryder Beach Road, S. Truro. New infestations were found as far south as Ballston Beach and west to Ryder Beach Road. Recent surveys by the Forest Service revealed new infestations south of Herring Cove Beach, along Route 6 - Mid-Cape Highway from Mt Aranat to Aldrich Rd., N. Truro, and along South Hollow and Highland Roads to the Highlands. One web was found and destroyed at Newcomb Hollow Beach.

The latest information indicates that the gross infestation area is 4400 acres, most of it Seashore property (map 2). Within the gross area, 1260 acres of scattered infestations can be delineated on Seashore lands.

EXPECTED 1987 CONDITIONS

Several attempts have been made to develop a method of predicting what damage could be expected from a given browntail population in the upcoming year (see Appendix). These attempts have met with little success. Lacking such a method, we can only assume that damage eventually will be severe, as it has been in most infested areas in the past. Likewise, we can assume the infestation will continue to spread.

MANAGEMENT ALTERNATIVES

After attending several planning meetings with Park Service personnel, the author interprets their objectives to be: (1) to prevent the loss of beach plum from the dune community, (2) to prevent "browntail rash" among visitors to the Seashore and nearby residents, (3) to protect the habitats of rare Lepidoptera that exist on the Seashore, and (4) to prevent defoliation of shrub species in high use areas.

In view of these objectives, five alternatives are available to the land manager in dealing with the browntail moth population on Cape Cod National Seashore: (1) no action, (2) removal of winter webs, (3) suppression with a biological insecticide, (4) suppression with a chemical insecticide, and (5) an Integrated Pest Management (IPM) program. Other methods, such as importing parasites for release, have potential but are not practical at this time.

1. No Action

The alternative of taking no action should always be considered. The advantages are that no costs are incurred and the environmental impact of an insecticide on non-target insects, especially on rare Lepidoptera species, are avoided.

Several natural factors act to reduce browntail populations. Low winter temperatures of -21°C (-5.8°F) and below kill the larvae in the webs and thus could be a control factor. However, the temperature on the Cape seldom drops that low.

Birds play an important role in checking the spread of browntail moth. While their attacks are perhaps more conspicuous while the insect is in the moth stage, the greatest number of insects are destroyed in the larval stages

at which time many species of birds not only consume the larvae, but also carry them to their young (Fernald 1903). Of more than 15 species that feed on the larvae, the yellow-billed and black-billed cockoos, yellow warbler, and bluejay are the most common visitants to infested shrubs and trees and feed freely on the larvae.[1]

Of the nine introduced species of parasites known to attack browntail moth larvae, only 4 cause any appreciable mortality: Montodontomerus aereus (Hymenoptera:Torymidae), Cotesia(Apanteles)lacteicolor(Hymenoptera:Braconidae), Townsendiellomyia nidicola and Compsilura concinnata (Diptera:Tachinidae). C. lacteicolor is not found on the Cape, and the populations of the others are not high enough to have any effect in suppressing or in preventing the spread of browntail moth.

In spite of the natural checks listed above, the outbreak of browntail moth did occur and there is more reason than not to believe it will continue. Thus, the likely consequences of no action are continued intensification and spread.

2. Removal of Winter Webs

Hand clipping or otherwise destroying winter webs in October through April is an effective method of reducing the population if there are four webs or fewer per shrub in isolated or localized areas.

Removal of webs from host plants is not a new control strategy . During the 1965-68 control projects, webs were removed in lightly infested areas between and bordering heavy infestations. No data is available on the effectiveness of this part of the treatment.

In 1973 Alton Robbins, a tree warden for the town of Dennis, collected data on the effectiveness of removing webs by handclipping. On the 743 M^2 area, 6.2 webs/M^2 of host plants were removed on Chapin Memorial Beach, Dennis. After treatment (1974), 0.2 webs/M^2 were counted on 390 M^2 area of host plants, a 31x reduction in the number of webs. Webs were removed annually until the beach was declared free of browntail moth.[2]

Webs were removed by handclipping from small specific areas on Great Island, Griffin Island, and Ballston Beach in 1977, 1981, 1984, and 1985 by Park Service personnel. Examinations of the same areas the year following treatment revealed no webs on the host plants.

Since browntail moths were first reported on the island and mainland of Casco Bay, Maine in 1967-68, the Maine Forest Service has done extensive scouting and clipping of winter webs and spraying in heavily infested areas to radicate the browntail moth populations. Through 1985, the population was relatively stable or held in check by clipping. However, in 1986, the population doubled from the previous years on three heavily infested islands. Also, viable webs were found on surrounding islands where they had not been noted for a number of years. On Vail Island where the infestation was high in

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[1] Personal communication from Mariko Yamasaki, Research Wildlife Biologist, Northeastern Forest Experiment Station, Durham, NH.

[2] Personal communication from Richard Kelliher, Insect Pest Control Specialist, Massachusetts Department of Environmental Management, Dennis, Massachusetts.

1986, there was no difference in the number of webs in both clipped and unclipped portions. Clipping was not effective on this island because the population intensities were too high. Maine has not experienced any branch or mortality caused by browntail moth on host trees or shrubs, even in the heaviest infested areas.

Since there are a few webs in Pilgrim Springs picnic area and along Highland to Coast Guard Roads to the beach, webs can be removed from the host plants because in both areas the principal cover type is pitch pine, a non-host. Also, webs can be removed from host plants on Ballston Beach because the infestation is very light. Although some clipping may have to be done annually due to reinfestation, the method probably will prevent the spread of browntail moths to other host plants in the immediate area. Perhaps 300 acres can be readily treated in this manner. Removing browntail moth webs in highly infested areas (more than 4 webs per shrub) may not be practical. These areas should be treated with an insecticide if suppression is desired.

Clipping can also be performed in high use areas such as beaches, bicycle paths, and adjacent to high infestations, but it will have to be repeated annually until the areas are treated or the population declines. The author estimates 170-180 acres fall in this category.

How many webs can be removed in a day depends on the density of the webs and the height and density of the host. However, based on scouting and clipping by the Maine Forest Service crew, one person can do:

8-10 acres/day when population density averages 15-20 webs/acre.
4+ acres/day when population density averages 50+ webs/acre.
2+ acres/day when population density averages 450+ webs/acre. \3

If the control strategy of removing webs in lightly infested areas is not implemented in 1987, web density may become too high in these areas to perform hand clipping.

3. Suppression with Biological Insecticides

Bacillus thuringiensis (Bt) is the only biological insecticide that is registered for browntail moth. The formulation Dipel 8L at a concentration of 64 billion international units (BIU's) per gallon is marginally effective in suppressing browntail moth when applied at a rate of 1/2 to 2 1/2 pints/100 gallons water with ground equipment, or 1-2 1/2 pints/acre with aerial applications.

The 1974 field evaluation in which two formulations of Bt (Dipel flowable and Thuricide 16B) were applied, reduced larval populations only to 56 percent of prespray levels, thus provided little foliage protection for beach plums and other preferred host plants.(McLane and others 1978)

A 1985 pilot control test using Dipel 8L was designed specificly to determine the number of dead larvae found on drop cloths, not the proportion of the whole population killed. It was not possible to determine quantitatively

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\3 Personal communication and Maine Forest Service reports from Dave Struble Entomologist, Maine Forest Service, Augusta, Maine.

what effect Dipel had on the browntail moth, though the treatment did kill more browntail moth than any other species.(Mello 1985)

Bt should be applied when the larvae are actively feeding on the foliage. Since larvae emerge two weeks prior to beach plum foliation, the larvae will eat the buds and flowers before foliation is completed. Therefore, the insecticide is marginally effective because little or no foliage is available. However, in light of our experience with spruce budworm, applying Bt to the buds in suffient amounts would kill many larvae. Applying it to other, already foliated host plants in the vicinity of the plum would prevent defoliation of these plants as well as prevent migration of the larvae to the plum.

Bt's chief advantages are its low environment impact and safety to applicators. The main disadvantages of using Bt are low amounts of target foliage at the time of spraying and that it may (depending on timing) adversely affect non-target Lepidoptera. In Mello's 1985 study, no rare Lepidoptera were found on the drop cloths, presumably because none was exposed at the time of spraying.

4. Suppression with Chemical Insecticides

The alternative of using a chemical insecticide should be considered in suppressing the browntail moth population. Properly applied, these insecticides are usually cheaper, more effective in suppressing high insect populations, and provide more foliage protection than Bt. Only carbaryl is registered for browntail moth control.

Carbaryl (Sevin 80S and Sevin XLR Plus) is a broad spectrum carbamate insecticide that is toxic to most insects . It is relatively inexpensive, poses little risk to applicators and to the public that might be exposed, and is reliable. Although Sevin XLR Plus is less hazardous to bees than Sevin 80S, both are still very toxic to bees when exposed to direct treatment or residues in blooming crops and weeds. It should not be applied directly to water and wetlands because it is toxic to aquatic and estuarine invertebrates.

Data collected from the 1966 spray project using Sevin 80s on the browntail moth population indicated that the insecticide was about 95 percent effective in reducing the larval population, even though there was little bud development on beach plum at the time of spraying. Because Sevin provides plant protection from 7 to 14 days, depending on climatic conditions and bud expansion, it is effective in protecting beach plums and other preferred host plants from further damage by browntail moth.

Carbaryl in the formulation Sevin XLR Plus or Sevin 80S is applied by ground equipment at the rate of 1 quart/100 gallons of water and 1 1/4 lbs/100 gallons of water, respectively.

5. Integrated Pest Management (IPM)

Integrated Pest Management is the combination of several methods of suppressing pest populations so as to reduce costs, mitigate environmental impacts, and enhance human safety. An IPM program to reduce the browntail moth population may be a combination of:

1. Mechanical removal of winter webs in low population areas;
2. Suppressing high populations with Bt or Sevin;

3. Monitoring the population by making web surveys in non-infested and infested areas.

Removal of winter webs and monitoring the population by determining web densities in infested and non-infested areas as an initial phase of developing an IPM program in 1987 can be implemented reasonably well. However, applying an insecticide to suppress browntail moth may require planning and field experience.

RECOMMENDATIONS

As indicated by the foregoing, discouragingly little is known about measures for suppressing the browntail moth. The recommendations below should be applied in 1987 and carefully evaluated before deciding exactly what should be done in 1988.

As a start; begin by mechanical removal of winter webs\4 from low population areas. These total about 420 acres. After the webs are removed from these areas, apply Bt with ground equipment to the clipped shrubs and to any other host (shadbush, cherry,etc.) nearby as soon as the larvae are active and feeding (in May 1987).

No action should be taken in areas of high infestation, which total about 840 acres, in 1987.

If Bt proves to be effective in substantially reducing the larval populations, in 1988 infestations bordering highly infested areas should be handclipped and the highly infested areas should be treated with Bt. If Bt is not effective, handclipping on a massive scale might work, but the Park Service would be better advised to consider using Sevin in these areas.

Should the Park decide to undertake a program in the winter and spring of 1987, FPM will provide technical assistance, including assistance in planning a posttreatment evaluation.

\4 Certain precautions should be taken by crews clipping branches infested with browntail moths. Since the hairs of the larvae can cause severe dermatitis, clothing should cover the entire body below the neck. To protect the face and neck an application of petroleum jelly is advised. A respirator is strongly recommended to prevent breathing of the hairs. Isopropyl alcohol applied to an irritated area provides some relief, but anyone severely affected should consult a physician.

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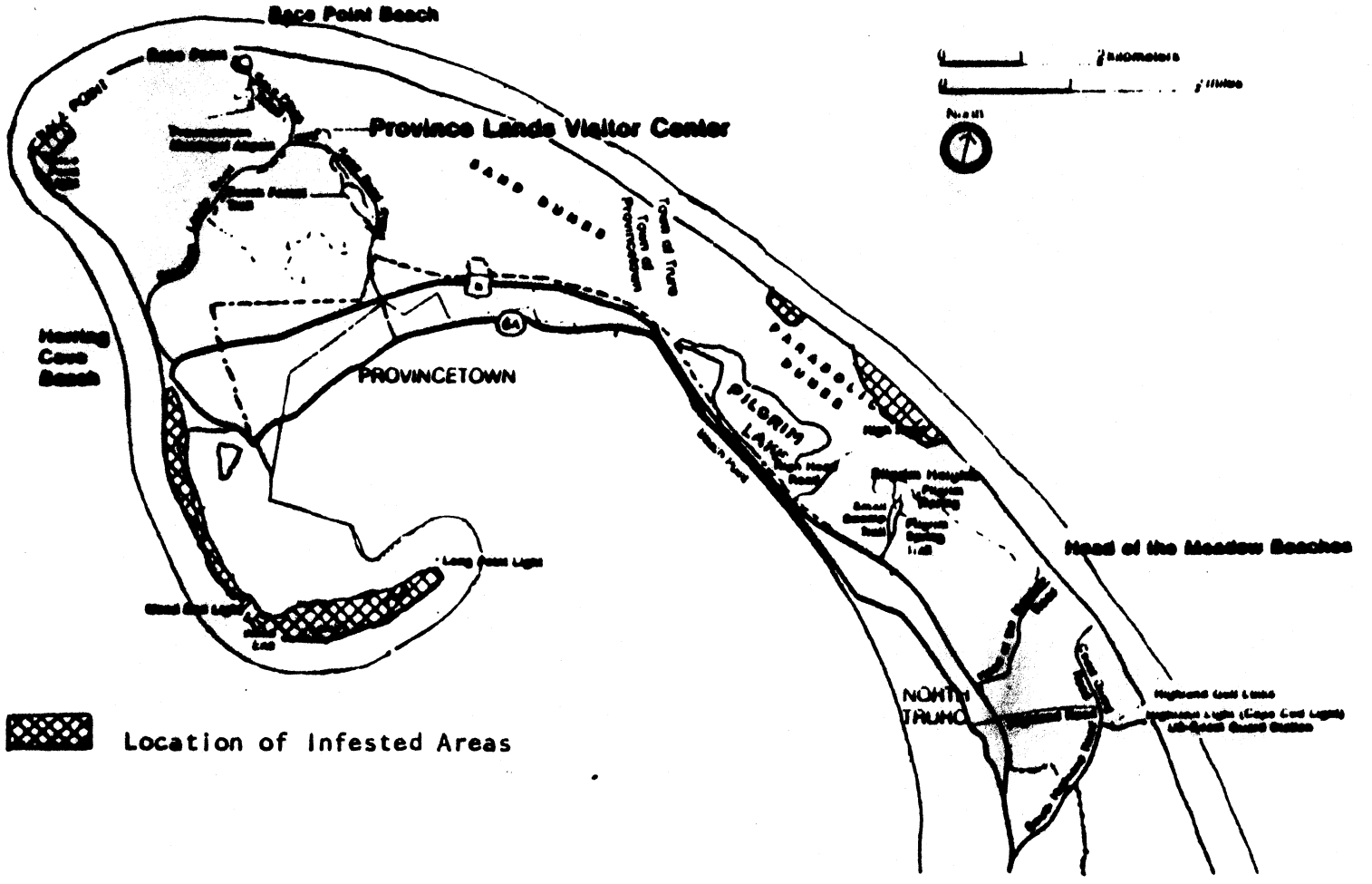
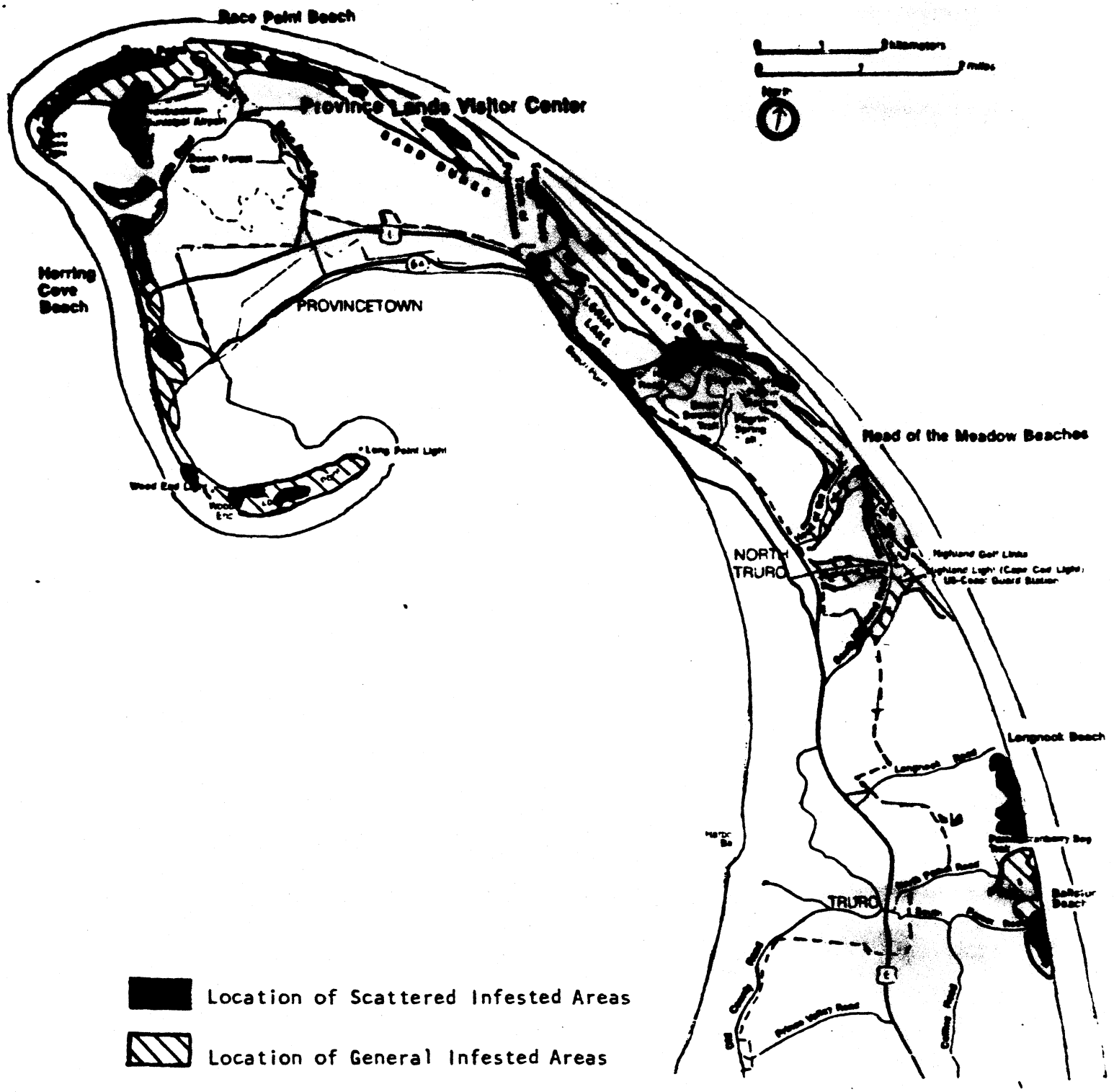


Map 1: 1965 Distribution of Browntail Moth Infestation on Cape Cod National Seashore (Scheider 1966).



Map 2: 1986 Distribution of Browntail Moth Infestation on Cape Cod National Seashore

APPENDIX

Methods of Evaluation

Now that infestations have moved inland on preferred and less favored host shrubs and trees, it is necessary that the land manager determine the intensity of the infestation and to assess damage caused by browntail moth.

Early methods of evaluation were mainly on the density of webs presence on host shrubs in a given area. If a few webs were found on host plants in an infested area(s), the infestation was considered to be light. If many webs were found on host plants, the infestation was heavy. In lightly infested areas, the webs were removed by clipping them from the host plants. In heavily infested areas, the area was simply treated with an insecticide. The evaluation methods were satisfactory for the purpose at the time, but they did not quantify the intensity of the infestation or the damage to be expected the following year.

It was not until 1974 that Paul Shaefer, on his study of the population ecology of browntail moths on Cape Cod, devised a method to measure the population density of the insect. His technique consisted of measuring the length and width of selected host plant clumps and the number webs recorded. The density was taken from web counts taken along parallel transect lines at 15 m intervlas. Samples were taken inside a plastic hoop of 0.6 M^2. Three samples were taken at each 15 m interval (Schaefer 1974). His method for adequate in measuring web population density, but a better method was needed to predict expected percent defoliation and actual damage.

In 1984, following a request from the Park Services for an evaluation, a method was devised by Forest Service to assess current web population density, expected percent defoliation and actual damage caused by browntail moth. This method consisted of measuring the number plants in 5 or 6 meter radius circular plots. The M^2 surface area with foliage (not the actual foliage area) of each plant within the plot was calculated from the diameter of each shrub (a erage length x width). The formula that was used to estimate surface area was half of the surface of a sphere, $S=\pi d^2/2$ because the shrubs were roughly hemispherical in shape.

Estimated degree of defoliation was determined as follows: The amount of foliage consumed by a browntail larva x mean number of larvae per web x number web per plot - by the amount of surface area of foliage in a plot. Estimated amount of shrub area surface defoliated by a browntail moth is about 170 CM^2 (0.017 $M^2 \pm .0025$). (Snowden 1984, unpublished data)

The above method will yield accurate predictions only some of the time because the larvae may consume the foliage while it is still in the bud.

In November 1986, an evaluation was made on three plots which were established in the spring to predict percent expected defoliation for 1987. Current webs were removed from shrubs in these plots and incubated in an environmental chamber in the Forest Service laboratory at 26 C (73 F) and 60 percent relative humidity to emerge the larvae in the webs. Percent expected defoliation could be based on the live larvae that emerged from the webs.

About 69 percent of the webs were viable. Of the 16 webs in which larvae didnot emerge eight, or 50 percent, were parasitized by chalcids (Hymenoptera:

Chalcididae) and tachinids (Diptera:Tachinidae). Dead adult parasites and empty fragmented pupal cases were observed in the webs. One Brachymeria probably intermedia adult (Hymenoptera:Chalcididae) issued from one of the webs. This is encouraging because it indicates that parasites are present in the browntail moth population on the Seashore. Expected percent defoliation is light in 1 plot and moderate in the other 2.